CLAIMS:

1. A method comprising the steps of:
    (a) covalently attaching species to the exterior of the fullerene carbon nanocage to form a derivatized fullerene carbon nanocage; and
    (b) inserting an endohedral doping agent into the derivatized fullerene carbon nanocage.
2. The method of Claim 1, wherein the derivatized fullerene carbon nanocage is a fluorinated fullerene carbon nanocage.
3. The method of Claim 1, wherein the step of covalently attaching decreases the potential energy barrier for the step of inserting.
4. The method of Claim 1, wherein the fullerene carbon nanocage is selected from the group consisting of fullerenes, buckyballs, carbon nanotubes, nested fullerenes, bucky onions, single-wall carbon nanotubes, multi-wall carbon nanotubes, carbon fibrils, and combinations thereof.
5. The method of Claim 1, wherein the endohedral doping agent is selected from the group consisting of a charged species, a neutral species, ion(s), atom(s), atom clusters, molecules, and combinations thereof.
6. The method of Claim 5, wherein the endohedral doping agent is radioactive.
7. The method of Claim 5, wherein the endohedral doping agent is inserted via ion bombardment.
8. The method of Claim 5, wherein the step of inserting comprises a high-temperature and high-pressure process.
9. The method of Claim 5, wherein the endohedral doping agent decays into a radioactive species.
10. The method of Claim 1, further comprising removing at least some of the covalently attached species from the exterior of the fullerene carbon nanocage after the step of inserting.
11. The method of Claim 1, further comprising adding bio-specific ligands or antibodies to the fullerene nanocage.
12. The method of Claim 11, wherein the step of adding occurs before the step of attaching.
13. The method of Claim 11, wherein the step of adding occurs during the step of attaching.
14. The method of Claim 11, wherein the step of adding occurs between the step of attaching and the step of inserting.

15. The method of Claim 11, wherein the step of adding occurs after the step of inserting.

16. The method of Claim 1, wherein the step of inserting comprises breaking and subsequent reformation of carbon-carbon bonds in the fullerene nanocage structure.

17. A method comprising:

(a) derivatizing a fullerene; and

(b) endohedrally modifying the fullerene.

18. The method of Claim 17, wherein the fullerene is a fullerene tube.

19. The method of Claim 18, wherein the fullerene tube is a single-wall carbon nanotube.

20. The method of Claim 19, wherein the sidewall carbon nanotube is derivatized on the sidewall of the single-wall carbon nanotube.

21. A composition comprising:

(a) a fullerene;

(b) a first species covalently attached to the fullerene; and

(c) a second species endohedrally located in the fullerene.

22. The composition of Claim 21, wherein the second species is selected from the group consisting of ions, atoms, molecules, and combinations thereof.

23. The composition of Claim 21, wherein the second species is radioactive.

24. The composition of Claim 21 further comprising a third species attached to the fullerene, wherein the third species is selected from the group consisting of bio-specific ligands, antibodies, and combinations thereof.

25. The composition of Claim 21, wherein, the first species is selected from the group consisting of bio-specific ligands and antibodies.

26. A composition comprising:

(a) fullerene carbon nanocage;

(b) a first species covalently attached to the fullerene carbon nanocage; and

(c) a second species endohedrally located in the fullerene carbon nanocage.

27. The composition of Claim 26 , wherein the first species covalently attached to the fullerene carbon nanocage is fluorine.

28. The composition of Claim 26 further comprising a third species attached to the fullerene, wherein the third species attached to the fullerene carbon nanocage is selected from the group consisting of bio-specific ligands, antibodies, and combinations thereof.

29. The composition of Claim 26, wherein the second species endohedrally located in the fullerene carbon nanocage is a radioactive species.

30. The composition of Claim 29, wherein the radioactive species is selected from the group consisting of T^+, T_2, ^3He, cobalt isotopes of small ionic radius, and combinations thereof.

31. The method of Claim 26, wherein the fullerene carbon nanocage is a fullerene tube.

32. The method of Claim 31, wherein the fullerene tube is a single-wall carbon nanotube.

33. The method of Claim 32, wherein the sidewall carbon nanotube is derivatized on the sidewall of the single-wall carbon nanotube.